

AERIAL DALL SHEEP COUNT, 1982, 1983 AND 1984
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE

SURVEY AND INVENTORY REPORT AR-84-2

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INTRODUCTION

An aerial survey of Dall sheep (Ovis dalli) was conducted in Gates of the Arctic National Park and Preserve (GAAR) including 41 hours of survey time in 1982, 122 hours in 1983, and 48 hours in 1984. Total survey time was about 211 hours over the three summers with a Bell Jet Ranger II helicopter on contract to GAAR.

Dall sheep populations in the central Brooks Range were very little understood when Gates of the Arctic National Park and Preserve (GAAR) was designated on 2 December 1980. About one-fifth of GAAR had been surveyed in 1974 (T. Smith, unpubl. survey data, Alaska Dept. of Fish and Game, Fairbanks) and portions of the upper Noatak River area at various times from 1974-1976 (Grauvogel 1974; Matthews 1976). A primary objective of the new park and preserve staff was to begin surveys of their most significant wildlife populations including Dall sheep. Several directives or issues precipitated GAAR staff to initiate sheep surveys in 1982, including:

1. ANILCA. The Alaska National Interest Lands Conservation Act (ANILCA) of 2 December 1982 directs that the National Park Service protect wildlife populations including sheep as noted in the establishing legislation (Sec. 201(4)(a)).
2. State Subsistence Regulations. In March of 1982 the Alaska Board of Game passed a new sheep subsistence hunting regulation for GAAR. The new regulations provided for the take of up to 3 either-sex sheep per person up to 50 total for the residents within the boundaries of GAAR (ADF&G 1984). In effect this restricted the hunt to only the residents of Anaktuvuk Pass. Prior winter and ewe harvests of sheep, although not "legal", had been practiced, but the numbers taken were felt to be about 8-12 annually (Nelson et al. 1982). However, good data and records of past subsistence harvests were lacking. Another impetus for the 1982 work was to establish baseline data prior to the new hunt regulations.

A second, more liberal subsistence sheep harvest was passed by the Board of Game in March of 1984. All resident zones for GAAR are now eligible. However, the season is the same, 1 August - 30 April, and the total limit remains at 50 sheep.

3. S. 49. This bill introduced in Congress proposed to convert some park status lands to preserve category. The sheep survey information is valuable to the deliberation process on this proposal.

A park and preserve-wide sheep survey was not a goal of the 1982 work. However, enough area was surveyed in 1982 that completion of the park was attempted in 1983 and

finally completed in 1984. Five count units near Anaktuvuk Pass previously counted in 1982 were recounted in 1984 after two harvest years under the new (1982) subsistence hunt regulations.

ACKNOWLEDGEMENTS

Gates of the Arctic National Park provided primary funding in 1982 and partial funding in 1984, and the Alaska Regional Office of the National Park Service provided primary funding in 1983 and partial funding in 1984. Richard Ring, Bruce Collins and Judy Liedberg of the GAAR staff provided extensive organizational and logistical support and field assistance. The Park also provided housing, seasonal observers and transportation. Observers included F. Singer, J. Liedberg, S. Duff, B. Sworts, S. Shellnut, D. Cambre, A. Woodall, R. Ring, D. Buchanan, A. Lovaas, and W. Commack. Alaska Department of Fish and Game (ADF&G) planned to fly the upper Noatak but was prevented by weather and Robert Stephenson of their staff flew with us to verify our classifications. Wayne Heimer (ADF&G) has provided comments and input at various times during the survey period. Bill Roberts (Homer Helicopters) provided safe and expert pilot skills to the survey crews.

METHODS

Earlier Surveys

Tony Smith (ADF&G) flew parts of what is now the southeast and central portions of GAAR in 1974, observing a total of 789 sheep. Aircraft was a Helio Courier 250 piloted by B. Bursiel. Smith pooled yearlings with ewes, but distinguished lambs and legal ($3/4+$ curl) and sub-legal (less than $3/4$ curl) rams in his classifications. Smith's count forms and survey maps along with those from the Kotzebue office were made available to us from the Alaska Department of Fish and Game through W. Heimer. Several 1970's Kotzebue-based ADF&G surveys in the upper Noatak were primarily conducted from Super Cubs (Grauvogel 1975, Matthews 1976).

1982-1984 NPS Surveys

We delineated 29 counting units in GAAR using lakes, rivers, glaciers, and smaller drainages as boundaries (Fig. 1). The area in ten of these units and portions of two others were surveyed by Smith in 1974 (see Fig. 1) although he did not use these same units. The purpose of our units was to facilitate counting and yearly comparisons. We recognize that sheep will move between units, but inter-unit movement (= counting error) was minimized by attempting to complete one unit in one days time and also minimized by the natural obstacles between units. Nevertheless, some movement occurred. Once in 1981 in Lake Clark and once in 1982 in GAAR, groups were observed during the surveys which were in the process of crossing wide valleys between count units.

We attempted to classify sheep into the following categories: ewe, lamb, yearling, and rams as $1/4$ curl, $> 1/2$ curl, $> 3/4$ curl, $> 7/8$ curl, $> 4/4$ curl. Winds were very calm during portions of the survey and at these times we also attempted to classify 2 year old ewes. We were only partially successful at this but nevertheless, we felt it increased our yearling accuracy, since some 2 year olds can be confused with yearlings. However, because we were only partially successful in differentiating 2 year old ewes, we later grouped them with adult ewes in this report.

The level of sex/age differentiation we achieved is greater than for any other aerial surveys in Alaska, except for those of Lyman Nichols on the Kenai Peninsula. We achieved this level through:

1. Landing the helicopter 100-300 yards from all groups of sheep comprising 16-20 or more individuals. We then got out of the helicopter and classified the animals using a variable 15-45X spotting scope and tripod. When possible, two of us independently classified sheep and if a discrepancy occurred, a recount was made.
2. When classifying just from the air we attempted to get a side

or head-on view of the animals at less than 60 yards distance. Any full run on the part of sheep complicated our classification plus was more disturbing to the sheep. We took the following steps to minimize running by sheep:

- We attempted to get all of our work done in one pass or two. Sheep responses increased with each succeeding pass. Four to six passes is too many, especially for large ewe/lamb groups.
- We landed near most groups of 16-20 individuals and 11 groups larger than 25, especially ewe/lamb groups. These larger, female-young groups were more likely to run. Groups of 1-3 ewes and ram groups often remain bedded or standing during passes. For the very large groups especially, we made our circling descent to the side of the group not over them, and shielded our descent and/or landing whenever possible with a hill or other natural obstacle to not disturb the sheep.
- In steep country, our flight pattern was typically along an elevation contour and as close to the side of the mountain as possible--this also minimized running by sheep since it shielded the sound and sight of our approach.

The location of each group of sheep was plotted on a 1:65,000 topographic map, where available, and otherwise on 1:250,000 topographic maps. Aspect and approximate elevation were taken off the map later. For each group, we recorded general habitat and visually estimated slope for the hillside surrounding the animal.

RESULTS

Survey Effort

A total of 23 of the 29 count units was surveyed in 1982-1984. No attempts were made to survey units 10, 11, 12, and 14 in the southeast quarter of the Park since T. Smith surveyed them in 1974 and we had already resurveyed six of his other count units. We therefore applied a correction factor to his counts of units 10-12 and 14. Alaska Department of Fish and Game, Kotzebue, planned to survey units 28 and 29 in the upper Noatak, but were unable to do so. However, these two units were surveyed in the early 1970's, unit 28 twice (1974, 1976), and also unit 29 twice (1974, 1976). In summary, of 29 count units, 6 (21%) were only surveyed once 1974-1976, 9 1/2 (33%) units were surveyed in 1982 of which 5 were also surveyed in 1974, 10 (35%) units were surveyed in 1983, and 2(7%) units in 1984 plus in 1984 recounts were made of 5 units counted in 1982.

A total of 9,583 (95%) of 10,057 Dall sheep observed during the three years was classified. We have tested our own accuracy on classifications through a small number of reclassifications and comparisons with spotting scopes and have found it to be

excellent, particularly amongst rams. However, a few lambs and yearlings may invariably be confused and 1/4 curl rams and adult ewes may be confused. No tests have been made of the magnitude of any bias. Presumably, the tendency would be to miss single 1/4 rams in a groups of ewes, and conversely to not detect a single ewe in a group of young rams.

Sheep Numbers

A minimum of 10,939 Dall sheep likely exist in Gates of the Arctic National Park and Preserve; 9,966 were actually counted in 23 of 29 count units during 1982-1984, 397 more were counted in two other units in 1974 (Grauvogel 1974), and another 576 were estimated in four units counted in 1974 by correcting for the 1974 counts (Smith 1974) by adding 100%. More sheep likely exist in Gates of the Arctic, but we conducted no tests of sightability.

A likely minimum of 9,422 (86%) of sheep occurred in park category lands and 1,517 (14%) in preserve category. Densities were three times higher in preserve (3.1 sheep/mi²) than in park (1.0 sheep/mi²). The ram ratio was 53 rams per 100 ewes in preserve and 59 in park, but legal rams (7/8+ curl) per 100 mi² (=Sportsman Index) was 25 in preserve but only 8 in park lands.

The highest sheep densities were in the north-central units, the Preserve, and the Killik River sectors (Table 1, Fig. 2). Gates of the Arctic possesses a great diversity of sheep habitats. Elevations, geology, prevailing winds and storms, and precipitation vary within the seven major sectors (Table 2). The northeastern preserve had a very high density of sheep. Many of these sheep were in count unit 18 (978 sheep) where no natural barrier separates them from the Park sector of the unit and where possibly sheep movements could affect the Park/Preserve comparison in other survey years.

Table 1. Dall sheep numbers in seven major sectors of Gates of the Arctic National Park and Preserve, 1982-1984.

Sector	Count Units	Mile ²	TOTAL SHEEP	Sheep/ Mile ²
Anaktuvuk - Doonerak	1-6,9,13 15,16,18a	2,577	4,223	1.6
Preserve	18b,17	485	1,517	3.1
Killik River	25-27	1,593	2,014	1.3
Noatak River	22,24,28, 29	1,899	1,742	0.9
Alatna River	19-21,23	1,945	443	0.2

N. Fork Koyukuk	10-12,14	961	576	0.6
lower John River	7,8	672	424	0.6
TOTAL	29	10,132	10,939	1.1

Trends

We counted 101% more sheep in six count units in 1982 than Smith did in 1974 (Table 2). Possibly, Dall sheep increased over this 8-year period. Our survey times were 24% higher and we used a rotary rather than a fixed-wing aircraft, which also could partially explain the difference.

We counted 266% more sheep on the north side of the upper Noatak in 1983 than Matthews (1976) did in 1976, and he counted 28% more than Grauvogel (1974) did two years earlier (Table 3). Many of the sheep Grauvogel counted in 1974 were just west of the boundary between 22 and 24 (Anorat Creek) and their movements across the boundary could explain the large fluctuations between those units in 1974 versus 1976. Dall sheep apparently increased +13% in five count units from 1982-1984. Survey, pilot, aircraft, and classifier were the same during both of these years, and survey times were nearly identical. The increase was consistently large in the four count units immediately west of Anaktuvuk Pass (up 24 + 11%, \bar{x} + S.D.) but in one unit southeast of Anaktuvuk Pass (No. 9b) sheep numbers were 36% less (Table 2).

Productivity

Lamb production was similar and yearling recruitment somewhat higher than in other Alaska Parks when compared to Gates of the Arctic (Table 4). Portions of the Lake Clark herd were known to be increasing rapidly 1981-1984. Production, particularly yearling recruitment (in June-July), was higher in the north-central portions of Gates of the Arctic where a 24% increase was documented, 1982-1984 (Table 4) than in the rest of the Park. Differences in production apparently were not inversely related to sheep densities (Table 4) as might be expected; the highest productivity and a documented increase occurred in the units with some of the highest densities in Gates of the Arctic.

Ram Statistics

The proportion of all rams combined and of legal rams only (7/8+ curl) in the total sheep herd of Gates of the Arctic (Table 5) was typical of many herds statewide (Table 6), but the percent of all rams that were 7/8 curl or larger was substantially lower than in three other Alaskan Parks (Table 6).

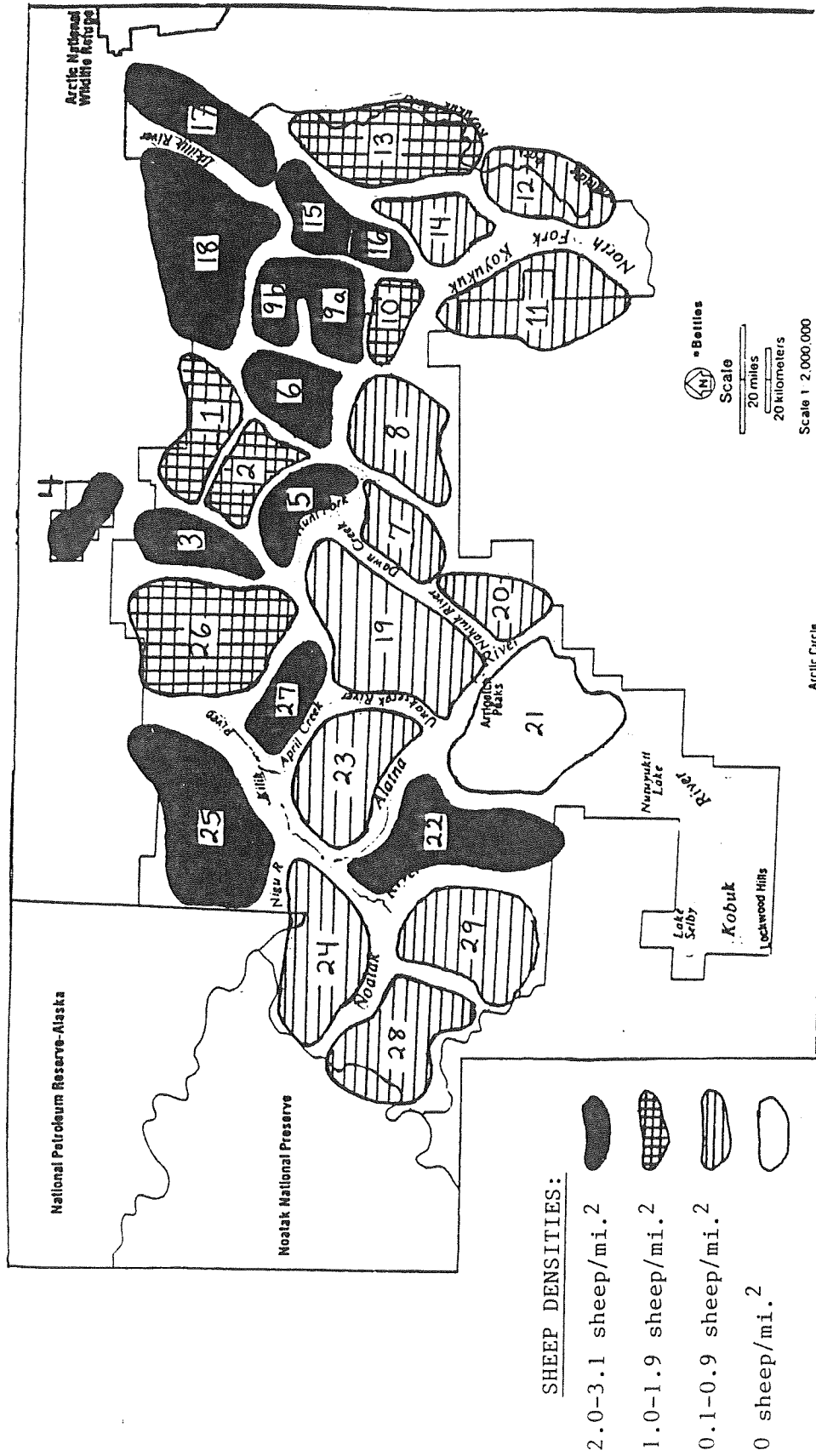


Fig. 2. Densities of Dall sheep in the various count units in Gates of the Arctic National Park and Preserve based upon helicopter counts in 1982, 1983 and 1984, except units 10, 11, 12, 14, 28 and 29 which were surveyed by Super Cub in the 1970's.

Table 2. Comparison of Dall sheep counts in nine count units, 1974-1984, Gates of the Arctic National Park and Preserve.

Count Unit	1974, Helio Courier		1982, Helicopter		1984, Helicopter		Percent Difference	
	Hours	No. Sheep	Hours	No. Sheep	No. of Sheep	Hours	Sheep	
1			6.8	462	578		+25	
2			3.5	216	237		+10	
4			2.0	101	137		+36	
5	2	57	3	210	264	+50	+268, +26	
6	6	277	6.7	514		+12	+85	
7	4.5	88	4.1	167		-9	+90	
8	3	148	4	255		+33	+72	
9b	2	103	3	201	128	+50	+98, -36	
16b	2	116	3.5	242		+75	+126	
SUBTOTAL:								
(1974-								
1982)	19.5	789	24.3	1,589		+24	+101	
SUBTOTAL:								
(1982-								
1984)				1,190	1,344		+13	

Table 3. Comparison of aerial counts in the upper Noatak River area presently within Gates of the Arctic National Park and Preserve, 1974-1983. Data is from Grauvogel (1974), Matthews (1976) and this survey.

Count Unit	1974	1976 1/	Percent Difference	1983	Percent Difference
Aircraft	Super Cub	Super Cub		Helicopter	
22	121	273	+125	1,015	+272
24	203	94	-54	330	+63
28	15	33	+120	---	---
29	32	76	+137	---	---
Subtotal for 22,24	324	367	+13	1,345	+266
TOTAL	371	476	+28	---	---

1/ Counts for 1976 in units 22 and 24 were corrected upwards 28% and 21%, respectively, since Matthews (1976) did not survey north of the Continental Divide in these units. These correction percentages were obtained from the proportion of total sheep seen north of the Divide in 1983 in the area Matthews omitted in 1976.

Table 4. A comparison of sex and age ratios of Dall sheep in Gates of the Arctic National Park and Preserve and other Alaska National Parks.

Park	Year	Units Sampled	Ratio per 100 Ewes			sheep/ mi ²
			lambs	yearlings	rams	
Gates of the Arctic:	1982	Nine Units ^{1/}	43	28	58	---
	1983	Ten Units	39	16	63	---
	1984	Seven Units	50	30	85	---
North-central Gates of the Arctic:	1982	1,2,4,5	43	32	78	2.0
	1983	3,9a,18,16	45	21	65	2.2
	1984	1,2,4,5	50	30	85	2.4
Killik River	1983 ^{2/}	25-27	41	21	75	1.3
Noatak River	1983	22,24	30	19	68	1.5
Alatna River	1983	19,20,23	44	21	66	0.3
Eastern Units	1983	13,15,17	36	12	62	1.6
Wrangell-St. Elias	1981	All of Park and Preserve	40	17	42	2.2
Denali	1981	All of Park	48	19	50	2.0
Lake Clark	1981	All of Park and Preserve	58	24	51	0.9
Noatak	1983	All of Preserve	42	15	65	0.5

1/ See Appendix IV for details on areas covered 1982-1984.

2/ Count unit 27 was surveyed in 1984.

Variations in ram ratio (rams per 100 ewes) and in the percent of legal rams were not consistent between sectors of Gates of the Arctic (Fig. 3). The Preserve had only a moderate ram ratio, and a modest percent of legal rams, but it possessed the highest density of sheep and therefore the highest sportsman's index (=number of legal rams per 100 mi²). The Anaktuvuk-Doonerak sector had a slightly higher density of sheep than the Killik River, but because of a lower percent of legal rams in the herd, it's sportsman's index was slightly lower than the Killik. The Noatak, Alatna and lower John Rivers all had low densities, and low sportsman's indices, although the Alatna had a high percent of legal rams in the herd and as a proportion of all rams. Statistics for the Noatak may be misleading in that sheep densities north of the river (count units 22 and 24) were 3-4 times higher (1.5 sheep per mi²) than south of the river (count units 28 and 29, 0.4 sheep per mi²). Only the recent helicopter classifications north of the river are included in the tables and the sex and age classifications south of the river could be different.

Table 5. Ram statistics in seven major sectors of Gates of the Arctic National Park and Preserve, 1982-1984.

Sector	Rams per 100 Ewes	Legal Rams as % of Herd	Legal Rams as % of All Rams	Legal Rams per 100 mi ²	Trophy Rams per 100 mi ²
Anaktuvuk- Doonerak	50	7	37	12	0.5
Preserve	53	8	30	25	2.3
Killik	75	11	34	14	1.4
Noatak ^{1/}	68	5	21	4	0.2
Alatna	66	10	36	2	0.5
N. Fork Koyukuk	--	--	--	--	---
lower John	45	5	24	3	---
TOTAL	58	8	32	9	0.6

^{1/} Statistics apply only to the much higher density units north of the Noatak (nos. 22 and 24) surveyed by helicopter in 19893 -- the units south of the Noatak (nos. 28 and 29) had sheep densities only 1/3-1/4 those north of the river and sex and age characteristics could have varied.

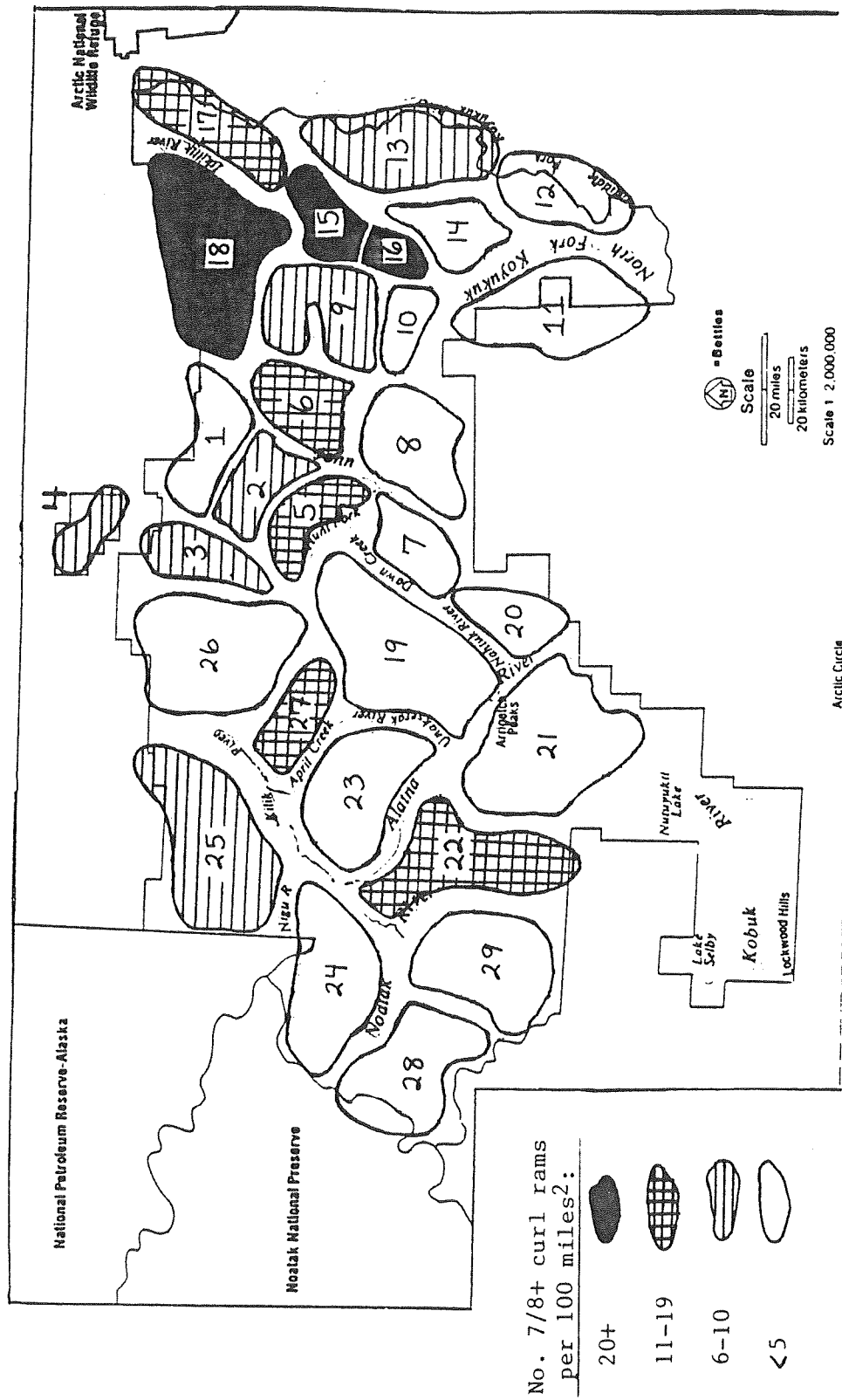


Fig. 3. Number of "legal" or 7/8+ curl rams per 100 mi.² in various count units of Gates of the Arctic National Park and Preserve.

Table 6. Comparison of ram size classes between Gates of the Arctic National Park and Preserve with other Alaskan Parks.

Park/Preserve	All Rams as a Percent of Herd	Percent of Rams 7/8 curl and larger	7/8+ Curl Rams as Percent of Herd
Gates of the Arctic	27.8	.32	8
Wrangell-St. Elias	19.7	.44	9
Denali	21.5	.49	11
Lake Clark	21.4	.44	9

Apparently, a shift to a more natural distribution of larger-horned rams occurred in Gates of the Arctic from 1982-1984. Sport hunting occurred in the Park area in the fall of 1980, therefore, the 1982 survey occurred only 1.5 growing seasons after the last hunt. The percent of legal rams increased six times and the percent of rams two times more than total sheep numbers increased in four count units (Table 7).

Table 7. Ram numbers in count units 1, 2, 4, and 5 in 1982 and 1984.

Numbers of:	1982	1984	Percent Difference
All sheep	983	1,216	+23
All Rams	246	355	+44
Legal Rams	40	99	+147
Trophy Rams ^{1/}	---	6	---

^{1/} Trophy categories of rams (9/8, 5/4 curl) were not distinguished in the 1982 survey. All 8/8+ curl rams were pooled.

Dall Sheep and Anaktuvuk Pass

About 38 Dall sheep were taken during the first subsistence hunt, 1982-1983, and apparently similar numbers the next two years. Traditionally, residents of Anaktuvuk, to whom the hunt was restricted in 1982-1984, have harvested sheep primarily from ATV and snowmachine travel routes along the upper Anaktuvuk, upper John, upper Chandler River, and Kollutarak Creek drainages. The

harvest is primarily restricted to count units 1, 2, the eastern edge of 3, the western edge of 18, and the northwestern edge of unit 6. At least 1,500 sheep inhabit this general area, of which only about 3-4% were harvested per year, 1982-1984. Apparently this level of harvest had no influence upon sheep population growth, 1982-1984. In units 1 and 2 where some sheep were harvested sheep numbers increased 18%, and sheep increased 31% in units 4 and 5 where harvests were unlikely (Table 2).

Dall sheep were only 1/6 as abundant within eight miles of the town of Anaktuvuk Pass in count units 1, 6 and 18 in comparison to the remainder of those units (Table 8). A comparison of sheep habitat close and distant from town was conducted in 1983 and 1984 and will be reported later (Dale and Singer, in preparation).

Table 8. Dall sheep densities in relation to the village of Anaktuvuk Pass, Alaska.

Count Unit	Year of Survey	Less than 8 Miles			Greater than 8 Miles		
		No. of Sheep	Miles ²	Sheep Per Mi ²	No. of Sheep	Miles ²	Sheep Per Mi ²
1	1982	22	38	0.6	440	207	2.1
1	1984	12	38	0.3	566	207	2.7
6	1982	28	49	0.6	473	190	2.5
18	1983	0	16	0	1,456	683	2.2
TOTAL	1982-1984	62	141	0.4	2,935	1,287	2.3

Dall Sheep on Gray and Dark Rock

A narrow band of gray limestone rock exposures occurs across the northern 2-10 miles of the Brooks Range in Gates of the Arctic National Park and Preserve. South of this band are a series of darker shales, and conglomerates. In the 1982-1984 surveys, we observed an average of 60% more sheep on the gray rock than dark rock, including more sheep on gray rock in 6 of 7 count units, but only 1/4 as many sheep on gray rock in unit 17 (Table 9). However, there were 37% more rams per 100 ewes and proportionately twice as many legal rams on dark rock (Table 9). Lamb and yearling ratios varied little between the two rock categories.

Table 9. Comparison of Dall sheep numbers on gray and dark rock in count units divided between the two categories along the northern edge of Gates of the Arctic National Park and Preserve.

Count Unit	Year	Rock	No. of Sheep	Miles ²	Sheep Per Mi ²	Ratio Per 100 Lambs	Year-lings	Ewes Rams	Legal Rams as Percent of Herd
1	1982	Gray	286	153	1.9	44	38	47	5
		Dark	180	92	2.0	41	31	76	7
2	1984	Gray	453	153	3.0	54	28	27	2
		Dark	125	92	1.4	50	30	237	26
3	1983	Gray	156	54	2.9	46	20	29	1
		Dark	198	101	2.0	58	28	71	6
17	1983	Gray	62	88	0.7	42	10	35	5
		Dark	468	167	2.8	31	12	65	10
18	1983	Gray	1,069	392	2.7	47	18	61	8
		Dark	387	307	1.3	31	15	78	13
25	1983	Gray	153	87	1.8	54	28	178	13
		Dark	693	702	1.0	59	32	90	14
26	1984	Gray	201	76	2.6	50	27	37	2
		Dark	955	509	1.9	38	9	48	12
TOTAL	1982-1984	Gray	2,380	1,003	2.4	48	23	52	6
		Dark	3,006	1,970	1.5	42	18	71	12

DISCUSSION

Gray versus Dark Rock

Population parameters were consistently different on gray and dark rock across the northern edge of Gates of the Arctic National Park and Preserve -- sheep numbers were more dense, but there were proportionately fewer rams and particularly fewer large-horned rams on the gray rock. Fecal collections to sample sheep food habits were made along with plot samples of vegetation availability on both gray and dark rock. These data are still being analyzed (Dale and Singer, in preparation) but apparently plant diversity and coverage was higher on the gray rock. Breakdown of the limestone on the gray rock area may result in higher Ca and pH levels in the soil. The limestone areas, however, may have possessed poorer escape and winter terrain since rock outcrops tended to be scattered and blocky with few ledges. Many sheep observed in the summers were feeding 200-400 yards from security terrain. We conducted no winter surveys and do not know

if the same high numbers of sheep inhabit the limestone areas in winter.

Population Trends

Dall sheep very likely increased in the northcentral part of the Park between 1982 and 1984. Pilot, aircraft and observers were the same on these flights. Sheep may have increased 1974 to the early 1980's in both the central Park and in the upper Noatak. Smith who conducted much of the 1974 survey was very experienced. Also, Matthews observed more sheep in 1976 than Grauvogel did in 1974. Sheep apparently increased in the lower Noatak during the same period (Singer et al. 1984). Alternatively, the increase in numbers may be due to greater survey efficiency in the 1980's. Our survey time was 28% higher than Smith's, similar to Grauvogel's, and about 80% higher than Matthew's. The helicopter holds three observers, the Super Cub holds one, and the Helio Courier holds two. Also, the greatest number of sheep seen could have resulted from both a sheep increase and also increased survey efficiency. Traditionally, Dall sheep populations were suspected to fluctuate little -- perhaps only 10-15% in most years (Hoefs and Bayer 1983). However, few Brooks Range populations have been studied and part of this herd likely increased 24% in only two years time, suggesting a very substantial sheep increase since the 1970's could have occurred.

Effects of Sport and Subsistence Hunting

Ram numbers apparently were still recovering to a more natural condition, 1982 to 1984, after cessation of hunting in 1981. Ram ratios and proportion of 7/8+ curl rams increased at a greater rate than other classes from 1982 to 1984 at least in the north central portions of the Park. The relative proportion of large-horned rams is lower in Gates of the Arctic than any other National Park Service unit in Alaska, including the adjacent Noatak Preserve which remained open to hunting. Possibly, horn growth per year is slower in the Gates of the Arctic than these other areas, or possibly, sport harvest of rams before 1980 was very intense in Gates of the Arctic.

We detected no influence of the limited either-sex, all-age sheep hunt near Anaktuvuk Pass. The approximate percent of the local Park population removed annually by the harvest (3-4%) is so low that little influence should be expected. The impact of a higher harvest rate on sheep at the northern extremity of their distribution in Alaska in the Brooks Range cannot be predicted, however. Caution is recommended against any large increase in the harvest until more information has been gathered on sheep population dynamics in this extreme northern environment.

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APPENDIX I. Raw counts of Dall sheep in 23 count units in Gates of the Arctic National Park, 1982-1984, and 6 other units survey in 1974 and 1976.

Count Unit	Total Sheep	Lambs	Yearlings	Ewes	Unclas- sified	Total Rams	Year Surveyed	Square Miles	Sheep/ Mi ²
1	462	83	68	192	9	110	1982	245	1.9
2	216	35	17	77	11	76	1982	159	1.3
3	354	78	36	151	15	74	1983	155	2.2
4	101	17	12	55	0	17	1982	48	3.1
5	204	44	20	90	7	43	1982	105	2.0
6	501	98	51	213	24	115	1982	239	2.2
7	169	27	27	82	3	30	1982	290	0.6
8	255	51	29	106	14	55	1982	382	0.7
9a	334	69	25	141	0	99	1983	335	0.6
9b	201	33	14	72	32	50	1982	---	
13	507	102	23	263	1	118	1983	485	1.0
15	349	50	27	140	0	132	1983	132	2.6
16	534	90	69	202	35	138	1982	205	2.5
17	521	81	29	253	1	157	1983	255	2.0
18	1,456	262	105	618	63	408	1983	699	2.1
19	229	51	20	106	15	37	1983	578	0.6

20	63	8	3	18	6	28	1983	181	0.3
21	0	0	0	0	0	0	1983	675	0
22	1,015	123	76	433	76	307	1983	497	2.4
23	151	22	15	59	0	55	1983	511	0.3
24	330	49	36	149	10	87	1984	421	0.8
25	846	129	96	305	2	314	1984	789	2.3
26	1,058	211	63	524	17	243	1983	585	1.7
27	201	24	18	67	0	92	1984	219	0.9
SUB-									
TOTAL	10,057	1,737	869	4,316	340	2,785			
28	33						1976	461	0.1
29	76						1976	520	0.1
10	202						1974	123	1.6
11	118						1974	407	0.3
12	130						1974	225	0.6
14	126						1974	206	1.1
TOTAL	10,742							10,132	1.1

1/ Arrived at by adding 100% more sheep to the 1974 counts of T. Smith as a correction factor after repeat counting 5 other of his 1974 count units.

APPENDIX II. Raw counts of Dall sheep in five count units resurveyed in 1984 and that were first surveyed in 1982.

Count Unit	Total Sheep	Lambs	Yearlings	Ewes	Unclas- sified	Total Rams
1	578	128	72	237	13	128
2	237	36	25	71	1	104
4	137	33	17	53	0	33
5	264	40	30	92	12	90
9b	128	11	6	43	0	68
TOTAL	1,344	248	150	496	26	423

APPENDIX III. Raw counts of rams in 23 count units surveyed by helicopter, 1982-1984, Gates of the Arctic National Park and Preserve.

Count Unit	Year	Total Rams	1/4	1/2	3/4	7/8	8/8	9/8+	Unclassified Rams
1	1982	110	48	22	20	6	7	--	7
1	1984	128	40	27	26	16	15	1	3
2	1982	76	15	25	16	7	7	0	6
2	1984	104	17	17	29	22	13	1	5
3	1983	74	32	13	14	8	6	--	1
4	1982	17	5	9	3	0	0	0	0
4	1984	33	7	9	8	8	1	0	0
5	1982	43	13	7	10	5	8	--	0
5	1984	90	29	17	20	11	7	4	0
6	1982	115	31	30	15	9	27	--	3
7	1982	30	6	10	6	4	2	--	2
8	1982	55	13	15	13	9	5	--	0
9a	1983	99	22	15	26	16	10	--	1
9b	1982	50	10	15	9	5	9	--	2
9b	1984	68	13	20	21	9	3	2	0
13	1983	118	21	33	35	16	11	1	1
15	1982	132	24	27	26	27	24	3	1
16	1983	138	32	33	21	24	23	--	5
17	1983	157	25	38	37	32	11	6	8
18	1983	408	77	75	101	79	50	9	17
19	1983	37	10	8	6	5	2	6	0
20	1982	28	5	5	6	2	7	--	3
21	1983	0	0	0	0	0	0	0	0
22	1983	307	49	82	66	38	28	3	41
23	1983	55	11	9	13	8	9	4	1
24	1983	87	27	21	24	5	8	1	1
25	1984	314	57	56	80	62	40	15	4
26	1984	227	46	52	52	46	19	1	11
27	1984	92	7	22	25	13	13	7	5

APPENDIX IV. Raw counts of Dall sheep on gray and dark rock in the northern edge of the Gates of the Arctic National Park and Preserve.

Count Unit	Year	Rock	No. of Lambs	No. of Yearlings	No. of Ewes	No. of Rams	No. of Legal Rams
1	1982	Gray	54	46	122	57	7
		Dark	29	22	70	53	6
2	1984	Gray	113	58	208	57	8
		Dark	15	9	30	71	32
3	1983	Gray	36	16	69	23	2
		Dark	42	20	72	51	12
17	1983	Gray	13	3	31	11	3
		Dark	68	26	222	146	46
18	1983	Gray	208	79	446	273	87
		Dark	54	36	172	135	51
25	1984	Gray	25	13	46	82	20
		Dark	154	83	259	232	97
26	1984	Gray	47	25	94	35	4
		Dark	164	38	432	208	113
TOTAL	1982- 1984	Gray	496	240	1,026	538	131
		Dark	526	224	1,257	896	357

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